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**By Joshua Lederberg**

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**T**ECHNOLOGY ASSESSMENT (TA) has been the subject of much agitation in political as well as scientific circles. According to former Rep. Emilio Q. Daddario (D-Conn.), chairman of a congressional subcommittee on research, TA is "sociotechnical research that discloses the benefits and risks to society emanating from alternative courses in the development of scientific and technological opportunities."

Despite its eminent reasonableness, the concept will also be used to justify the deferral of burdensome expenses while proposals like the conquest of cancer are assessed. It will also be a lightning rod for the attacks of doctrinaire anti-intellectuals of both left and right. If these extremes can be avoided, TA may become a new viewpoint of great value in preventing the historic mistakes and achieving the best values for our investments.

**A Political Problem**

**I**T WOULD be a mistake to think of TA as merely another technical device, like choosing the most economically productive site for a dam. In fact, the most important questions of TA are not technological at all, but have to do with the priority given to various kinds of "benefits and risks to society."

Some of the harshest criticisms of technology are directed to its service to military security needs, out of proportion to other social purposes. But this choice of national priorities is a political decision in which sophisticated technical analysis plays, or certainly should play, only a supporting role.

We have been chided for lacking a coherent "science policy," but in many ways this merely reflects the dissonances in our political mechanisms for harmonizing our basic priorities. Proposals to establish a centralized Department of Science and Technology would worsen the situation, unless it were the Office of Management and Budget under another name. Otherwise, such a department would be quite unable to establish and enforce the fundamental policies of allocation of resources that determine our national course.

It is much easier to suggest a rational science policy than to achieve it. First, we would plan the overall budget in relation to the urgency of unmet needs in the various fields of social action — defense, health, world development, education, industrial productivity, and employment, etc. Then each agency would apportion a fraction of its operational budget to applied research in relation to its own analysis of the long-range payoff of various levels of investment.

Different functions can evidently profit to varying degrees from the kind of sophistication that further research can bring. Research probably should not take as large a part of an adequate urban development budget as it should of health or strategic defense systems. The poverty of urban technology is more a reflection of our failure

of commitment to solve our urban problems altogether than it is of failure of TA within that area.

All in all, the most effective action that Congress could take for the improvement of TA would be the establishment of the Joint Committee on the Budget, an innovation repeatedly endorsed by the Senate but uniformly rejected by the House as an intrusion on its constitutional prerogatives over appropriations.

Congress is then unable to approach the rationalization of the budget in a well-defined forum where competing priorities can be placed in direct confrontation. The effort remains entirely in the darker recesses of the Executive Branch through the Office of Management and Budget, with advice from the various departments and other White House advisers, like the Office of Science and Technology.

The recent reorganization of the Budget Bureau has done a great deal to build an effective structure and staff for this indispensable function. However, this further strengthens the executive domination of the process. That crucial decisions must then depend on information and advice clothed in the executive privilege is nicely illustrated by the administration's refusal to release the Garwin report on SST as an almost inevitable consequence of this method of operation.

Insofar as TA depends on a democratic determination and an informed choice among well-exposed alternatives, Congress cannot now properly fulfill its responsibilities. The reactions will inevitably include near-hysterical attributions of environmental catastrophe, like those painted for the SST, in the absence of a credible exposure of all the relevant data available to the Executive Branch.

The new Joint Committee on the Environment and Technology, approved by the last Congress, may be able to fulfill part of this function, but its authority will be sharply limited by its lack of jurisdiction over specific legislation, agencies or funds.

**Rights and Intrusions**

**T**HE IMPACT of technology on environmental values has occupied an almost inordinate part of recent attention to TA. This partly reflects a gap within law and social precedent in defining the rights of individuals to quiet, to breathable air, to uncluttered views of natural landscape. Nor can such rights be established without considering their intrusion on other rights and aspirations, as in the use of land, the exploitation of natural resources fairly purchased and other avenues of economic gain.

While these are being thrashed out, technology rather than policy is the focus of many recriminations, perhaps because, rather than in spite, of the moral sensitivity of technologists about accusations that they work for other than the public good. As we develop a structure of the law of environmental rights, a great deal of TA will flow naturally from the assertion of such rights in court. Even more important, the anticipation of future claims is already beginning to shape techno-

logical policies in directions that are mainly, if not always, constructive.

The quality of the environment is, however, but one of many important values that must be encompassed by TA. For example, can a Joint Committee on the Environment properly assess the impact of technological progress on our defense posture, on domestic crime and social harmony or on our foreign relations, as might follow from its influence on national and world economic development? Nor could one sensibly factor out the influence of technological from those of other policies on these problems.

We will then be left with some improvement, but a still imperfect coordination of overall priorities for the budget, an advantageous focus of attention on environmental problems and a continued relegation of many other concerns to the spheres of influence of entrenched powers in the political establishment.

**Congress Has Limits**

**C**ONGRESS WILL, however, have gained something toward better staffing of its needs for advice about science as a counterweight to the large organization of scientific advice in the executive. There are still built-in limits to the effectiveness of a science advisory structure for Congress. Sound advice can be formulated only in response to concrete plans and to detailed information that can hardly be separated from the executive function.

To get better technical advice, Congress should certainly strengthen its staff for coordinating functions rather than as primary sources of information. It should strengthen the Freedom of Information Act, which it can do

without destroying the presidential prerogatives — e.g., an adviser could be liberated to testify about what he told the President, even if the reply might well be privileged. Then Congress would have easy access to the same set of experts who advise the Executive Branch in their alternative role.

Congress is also beginning to adopt the technique of contracting for information and studies from existing organizations, like the National Academy of Sciences, but experts' time costs money, and Congress will be unable to satisfy its demands for parity with the executive unless it provides a specific budget for the purpose.

Individual congressmen will often have access to a wide range of technical expertise among their own constituents but may still have trouble meeting travel and communications expenses to make effective use of it. In this respect again, Congress has given the executive an overbearing advantage by default. The nation thereby fails to get the fullest advantage of the congressional hearing as the leading forum for the ventilation of complex issues, by which the public can best participate in TA.

## Protecting Universities

AS ALREADY mentioned, a Department of Science would not solve the problem of TA among the various functional missions of government, a view widely shared by most of the agencies themselves. Dr. Philip Handler, president of the National Academy of Sciences, has, however, advocated such a department to answer the needs of the nation's universities and other research institutions.

They are now hired to do specific tasks by various agencies like Health or Defense without these having the means of lawful authority to look out for the impact of specific mission-oriented projects on the vitality and integrity of the institutions themselves. Thus medical schools have had to bootleg the production of doctors when funds were earmarked for research.

When the Department of Defense or AEC becomes unpopular as an agency for subsidizing basic research, and is restrained by measures like the Mansfield amendment (confining new DOD-supported projects to those that have immediate military relevance), the universities are simply left out on a limb.

A broad-based Department of Science it was thought, might be more attentive to the needs of the universities as institutions. This requirement is painfully evident, but it would be more straightforward to carve out a Department of Education, with divisions of graduate education and research, to be sure that the universities can be saved as broad-based centers of higher learning.

The Department of Health, Education and Welfare as now constituted is obliged to give such a high priority to short-term needs in health services, too long neglected as a federal responsibility, to provide a fair-minded channel for longer-term but equally vital needs of transmitting and expanding knowledge. In such a climate, proposals like a National Cancer Authority seem like the only way to attract attention to the realistic needs for long-term solutions to health problems that depend on new knowledge.

The ethical or human value side of TA can be illustrated by efforts

to assess the payoffs in health research. A common approach is to ask the price that would be deemed a fair bargain for averting the death not of a named individual but of a "statistical unit of the population."

For example, some system studies in HEW point to the "discounted future earnings" of an average citizen as a fair "price" for his life. A 1966 figure of \$125,000 in fact turns out to be a fair match to the levels of marginal investment that we make for industrial and transportation safety, which range from \$10,000 per life in some traffic environments to about \$1 million for aircraft.

There are, however, many logical and ethical dangers to this cost-accounting approach. In the first place, as Harvard economist Thomas C. Schelling has pointed out, the social cost of an individual death in such terms may actually tend toward zero. If an individual is fairly compensated for his labor while he lives, it will be precisely zero. In the real world, it may even be negative, through the accelerated use of the death taxes on a rich man's estate, or through the relief of tax-supported welfare services provided a poor man. (Economically, many of us are worth more dead than (alive.) Only a rare saint is contributing more to the community than he receives, making his death a net economic loss.

This kind of evaluation of life is more appropriate, as other economists have pointed out, to a system of slavery than to a democratic society. We may even say that one central purpose of society is collective action to minimize death and suffering.

Nevertheless, this kind of life-value reasoning is seriously invoked by some, not merely to give rough estimates of the "value of health" but to justify certain kinds of health-oriented programs and to downgrade others. (Until they themselves begin to age, many youth may be quite accepting of suggestions that we ignore cancer and heart disease as areas of productive research investment.)

## The Wrong Question

EVEN IN MORE narrowly economic terms, however, the life-earnings argument overlooks the role of healthful life expectancy beyond retirement as an incentive to civic cooperation in earlier years. In modern times, the protection of life is an indispensable part of the social contract. Productivity is no more valid a basis for calculating the legitimacy of investments in health than it is in, say, national defense. In a free society, the proper question is not "What is it worth to society to prolong (or end!) your life?" but "How much are you willing to be taxed for the prospects of a healthier life?"

The further apportionment of the health tax between present services and deferred benefits from better knowledge remains as a legitimate question for sociotechnical analysis. We might keep in mind, however, how little there is to be mined by digging deeper into the research budget. All the hullabaloo about the extravagant funding of research notwithstanding, it takes only about 3 cents out of the health dollar today.

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Note: This article was in press at the time of Pres. Nixon's State of the Union message (Jan. 22). In this, the president charted some important changes in health research policy. If implemented, some of the sarcasms in this article should be repudiated.